

Water Quality Module Appendix

Profiles Of Wetland Classes And Subclasses For Lowland Washington (Draft, Department of Ecology 3/97)

Class: Riverine

Riverine wetlands occur in floodplains and riparian corridors in association with stream or river channels. They lie in the active floodplain of a river, and have important hydrologic links to the water dynamics of the river or stream. The distinguishing characteristic of riverine wetlands in Washington State is that they are frequently flooded by overbank flow from the stream or river. The flooding waters are a major environmental factor that structures the ecosystem in these wetlands. Wetlands that may lie in floodplains but are not frequently flooded are not classified as riverine.

Surface and shallow subsurface water movement in most Riverine wetlands is from the valley sides toward the stream channel, from the stream channel toward the adjacent floodplain and downstream during overbank events. Additional water sources may be groundwater discharge from surficial aquifers, overland flow from adjacent uplands and tributaries, and precipitation.

Water leaves Riverine wetlands by surface flow returning to the river or stream channel after flooding or a rain event. The wetlands also may lose subsurface water by subsurface discharge to the channel (called interflow), movement of water to deeper groundwater through permeable geologic formations, and evapotranspiration.

Many Riverine valley wetlands are associated with rivers that are very dynamic. Their proximity to the river facilitates the rapid transfer of floodwaters in and out of the wetland, and the import and export of sediments. These wetlands are subject to frequent flood disturbances that may reset the "successional clock." The dominant vegetation in these wetlands may be representative of any of the seral stages possible; from early successional, emergent species, to late successional forest species. Near the headwaters of streams and rivers, Riverine valley wetlands are often replaced by depressional or slope wetlands, where the channel (bed) and bank disappear, and overbank flooding grades into surface or groundwater inundation. In headwaters, the dominant source of water becomes surface runoff or groundwater seepage. For the purposes of classifying wetlands, wetlands that show evidence of frequent overbank flooding even if from an intermittent stream, are considered to be in the class Riverine.

The downstream extent of riverine wetlands is where they normally intergrade with estuarine fringe wetlands. According to the hydrogeomorphic classification, the riverine class is dominated by unidirectional flows (Brinson 1993, Brinson et al. 1995). The interface with estuarine fringe occurs where the dominant hydrodynamics change to bidirectional flows, tidal, flows (Brinson et al. 1995). This interface has been significantly modified in western Washington by diking. Many wetlands that were once freshwater tidal (a subclass of estuarine fringe in Washington) are now either Riverine or Depressional (depending on the frequency of flooding).

Riverine wetlands normally extend perpendicular from the stream or river channel to the edge of the area that is frequently flooded (also known as active floodplain). Wetlands in large floodplains that are found outside the areas frequently flooded, and in landscapes with great topographic relief and steep hydrostatic gradients may function more like slope or depressional wetlands because the water regime is dominated by groundwater sources (see discussion in Brinson et al. 1995).

Field Characteristics for Riverine Wetlands in Washington State: The operative characteristic of Riverine wetlands in Washington State is that of being "frequently flooded" by overbank flows. The assessment teams and technical committee, however, decided that this characteristic could only be determined from field indicators. The water regime of Washington's wetlands have enough variability between dry and wet years that a frequency of flooding (e.g. flooded at least once every two years) could not be used. The field indicators that are to be used to classify a wetland as riverine are still being developed.

Subclass: Flow-through

Riverine Flow-through wetlands are those that do not retain surface water significantly longer than the duration of a flood event. Water tends to flow through the wetland rather than pond in the wetland. Usually the water does not remain in the wetland more than several

days after the surrounding landscape is drained. Soil saturation, however, may be maintained by groundwater seepage from valley walls. Flow-through wetlands usually have evidence of active erosion and deposition and have a dynamic, fluctuating hydroperiod that closely matches that of the stream or river.

The wetlands in this subclass tend to be found in, or adjacent to, the active channel of a river or larger stream. They may be the vegetated bars in the active channel or form on recent alluvial deposits along the sides of the channel or within the channel.

Field characteristics of Riverine Flow-through Wetlands for Western Washington: has a less dense herbaceous understory and commonly contains stinging nettle contains deciduous shrubs and trees (conifers less likely) the soils are more coarse and have higher mineral content than those found in the Impounding subclass the vegetation tends to be less diverse than in the Impounding subclass. This profile will be expanded to include descriptions of how wetlands in this subclass performs the 16 functions after reference data are collected during the field calibration of the models.

Subclass: Impounding

Riverine Impounding wetlands are those that retain surface water significantly longer than the duration of a flood event. Impounding wetlands tend to hold water longer than a week after a flood event. These wetlands are found within a topographic depression on the valley floor or in areas where natural or man-made barriers to downstream flow occur. The depressions may be filled with sediments or organic deposits. The critical characteristic, however, is that these wetlands retain flood waters after an event longer than the surrounding landscape. The impounding wetlands often have no outlet, or a constricted outlet, and have a hydroperiod that is less dynamic than that found in the adjacent stream, river, or "flow-through" wetland in the same valley. Most of the Impounding riverine wetlands are in the less dynamic parts of the floodplain; often on floodplain terraces or in old oxbows. Many may have peat accumulations that have become isolated from the usual riverine processes, and they are subjected to long durations of saturation from surface or groundwater sources. Riverine processes will dominate only during the flooding event, though the groundwater levels may be controlled by water levels in the hyporheic zone through hydrostatic processes.

Many wetlands in lowland Washington fall into this subclass because their surface water connections have been reduced by dikes or roads. These wetlands at one time did not retain floodwaters longer than the actual flooding event, but now do so because of some blockage.

Field characteristics of Riverine Impounding wetlands for western Washington: more herbaceous understory and commonly contains skunk cabbage aquatic vasculars are frequently present if there is a forested component, may contain conifers contains finer soils which may have a higher organic content vegetation tends to be more diverse than in Flow-through wetlands.

This profile will be expanded to include descriptions of how wetlands in this subclass performs the 16 functions after reference data are collected during the field calibration of the models.

Class: Depressional

Depressional wetlands occur in topographic depressions, that exhibit a closed contour interval(s) on three sides and elevations that are lower than the surrounding landscape. The shape of depressional wetlands vary, but in all cases, the movement of surface water and shallow subsurface water from at least three cardinal directions in the surrounding landscape is toward the point of lowest elevation in the depression. The movement of surface water in depressional wetlands is also vertical (up and down). Depressional wetlands may be isolated with no surface water inflow or outflow through a defined channel, or they may have permanent or intermittent, surface water inflow or outflow in defined channels, that connects them to other surface waters or wetlands. Streams draining into a wetland may modify the topographic contours of the depression where they enter or exit the wetland. Depressional wetlands with channels or streams differ from riverine wetlands in that their ecosystem is not significantly modified by riverine flooding events. Headwater wetlands would be classified as depressional because overbank flooding is not a major ecological "driver".

Depressional wetlands may lose water through intermittent or perennial drainage from an outlet, by evapotranspiration, and flow into the groundwater at times when they are not receiving discharge from groundwater.

The Flow-through and Closed subclasses have very similar positions in the landscape that do not warrant separate geomorphic profiles. Differences between the subclasses are based on the functions they perform. The geomorphic characteristics of depressional wetlands in lowland western Washington are as follows:

1. Depressional wetlands in lowland western Washington are found in the following geomorphic settings; 1) Former kettleholes left by receding glaciers, 2) in depressions on top of clay lenses in glacial outwash, such as the area between Olympia and the Chehalis River, 3) headwaters of lowland streams, 4) alluvial terraces

above the existing floodplains, and 5) depressions in glacial till.

2. Many depressional wetlands have well developed peat deposits because the outflow, if it exists, is above the base of the depression. Thus, organic matter will tend to collect.

Field Characteristics for Washington State: Depressional wetlands in the lowlands of western Washington lie in topographic depressions where the slope on at least three sides above the wetland is greater than 1%, and that are not within the active floodplain of a stream or river. There may be a stream going through the wetland, but if so it is not the major source of physical energy to the system.

The topographic depressions that characterize the position of this class in the landscape can be very small with only slight differences in elevation between the wetland and surrounding uplands. Some depressional wetlands are found on relatively flat surfaces. They are formed in depressions that exit in soils with low permeability such as glacial till plain.

Very small wetlands found in surface depressions with only a 1-3 foot topographic relief may be difficult to classify. If such small wetlands form a mosaic on a landscape that is flat it may be more appropriate to classify them as a single wetland in the "Flats" class if the only source of water to the wetland is precipitation. If the wetland receives a significant amount of its water from a surrounding contributing basin, however slight the topographic relief, it would be classified as a Depressional wetland. A Flats wetland, on the other hand, receives its water by direct precipitation over the area within the wetland only.

Subclass: Flow-through

Depressional Flow-through wetlands are those that have a surface water outflow to a stream or river that eventually discharges into the ocean for at least part of the year. Inflow may be from surface water flowing down from the surrounding topographic relief, from an intermittent or permanent stream(s), or from groundwater.

This profile will be expanded to include descriptions of how wetlands in this subclass perform the 16 functions after reference data are collected during the field calibration of the models.

Subclass: Closed

Depressional Closed wetlands are those that have no surface water outflow to channels, streams, or rivers. Closed depressional wetlands may have surface water

inflow but no outflow through a defined channel.

This profile will be expanded to include descriptions of how wetlands in this subclass perform the 16 functions after reference data are collected during the field calibration of the models.

Class: Slope

Slope wetlands occur on hill or valley slopes. Elevation gradients may range from steep hillsides to slight slopes. Principal water sources are usually groundwater seepage and precipitation. Slope wetlands may occur in nearly flat landscapes if groundwater discharge is a dominant source of water and there is flow in one direction. The movement of surface and shallow subsurface water is perpendicular to topographic contour lines. Slope wetlands are distinguished from the riverine wetland class by the lack of a defined topographic valley with observable features of bed and bank. Slope wetlands may develop channels but the channels serve only to convey water away from the slope wetland.

Field characteristics for Washington State: Slope wetlands in Washington are found on hillsides or at the edge of hill where they grade into a river valley. They are identified by the fact that: 1) they are on a slope, even if very gradual, 2) they lack closed contours and cannot store surface water, and 3) they have no obvious surface water inflows such as streams or channels.

Subclass: Slope Connected

Slope wetlands with a surface water connection, at least periodically, to an intermittent or perennial stream or other surface water body connected to a stream or river that discharges into the ocean.

Subclass: Slope Unconnected

Slope wetlands isolated from streams or surface waters.

Class: Flats

Flats wetlands occur in topographically flat areas that are hydrologically isolated from surrounding groundwater or surface water. The main source of water in these wetlands is precipitation. They receive virtually no groundwater discharge which distinguishes them from depressional and slope wetlands. The DOE Technical Committee decided that for Washington there was no need to create two separate classes for Flats as proposed in

the current HMG documentation. "Flats" wetlands are not very common in the state, and the committee judged that both organic and mineral flats found in the state perform the same functions and do not need to be separated. The DOE team developing the models for the flats, however, may decide that further divisions are necessary.

Class Lacustrine Fringe

Lacustrine fringe wetlands occur at the margin of topographic depressions in which fresh surface water is greater than 2 meters deep. They are found along the edges of bodies of water such as lakes. The dominant surface water movement in fringe wetlands has a bi-directional horizontal component due to winds or currents, but there may also be a corresponding up and down vertical component resulting from seiches, wind, or seasonal water fluctuations.

Field characteristics for Washington State:

Lacustrine fringe wetlands are those adjacent to bodies of freshwater that are at least two meters deep with no evidence of water flow in one direction. Some wetlands may be adjacent to rivers that are more than two meters deep but these would be classified as riverine because there is measurable flow in one direction.

No subclasses are proposed for the Lacustrine Fringe class in Washington State.

Class: Estuarine Fringe

Estuarine fringe wetlands occur at the margin of topographic depressions in which marine waters are greater than 2 meters deep. They are found along the coasts and in river mouths to the extent of tidal influence. The dominant source of water is from the ocean or river. The one unifying characteristic of this class is hydrodynamic. All estuarine fringe wetlands have water flows dominated by tidal influences with water depths controlled by the tidal cycles.

Subclass: Estuarine Saltwater Fringe

Estuarine fringe wetlands in which the dominant water flows have salinities that are higher than 0.5 parts per thousand.

Subclass Estuarine Freshwater Fringe

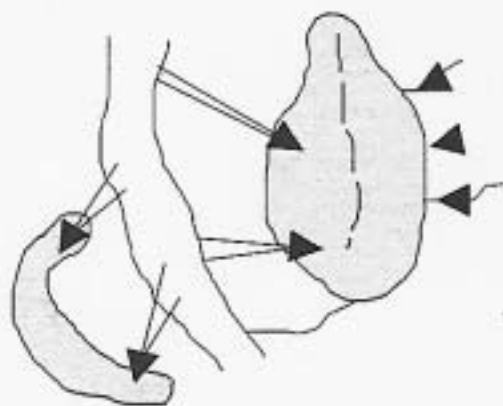
Estuarine fringe wetlands in which the dominant water flows are tidal but freshwater, with salinities below 0.5 parts per thousand.

HGM CLASSIFICATION FOR WASHINGTON

RIVERINE

flooded frequently
by river:
"Frequently" to be
determined by field
indicators

Impounding

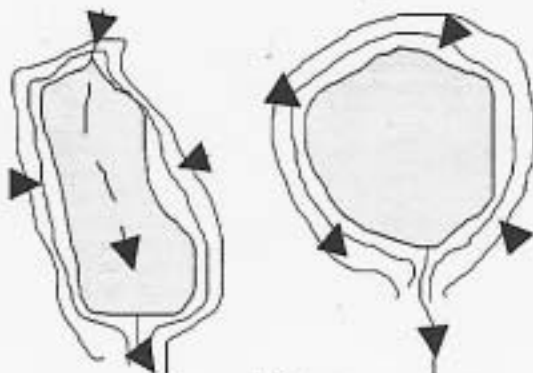


Flow-through



DEPRESSIONAL

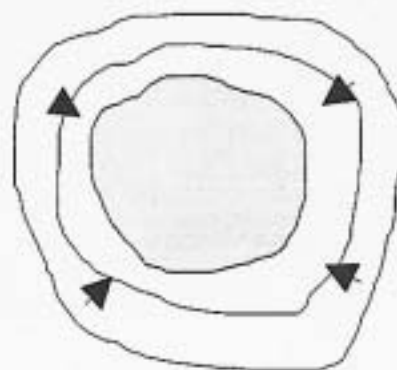
Flow-through



flooded
infrequently by
river



Closed



Linkage Between Water Temperature and Watershed Conditions--Making Vulnerability Calls

Prior to the synthesis steps that involve all of the assessment modules, the water quality analyst will consider watershed factors other than riparian vegetation that may affect the vulnerability of streams to temperature change. The water quality analyst will work with other analysts and the products they developed from the hydrology, mass wasting, channel, riparian and fish habitat modules, as well as ancillary data on fisheries resources, to develop an integrated assessment of the likely effects of forest practices on stream temperature and other water quality parameters. The following steps describe the general process by which several module assessments are used to create the water temperature vulnerabilities. It is important to bear in mind that water quality issues not covered in this manual may arise. The analysts must rely on the data describing the situation and their knowledge of watersheds and water quality to create vulnerability calls.

The initial determination of water temperature vulnerability is based on estimates of potential and minimum allowable view-to-the-sky as it is influenced by riparian vegetation and topographic blocking. The method described in the water quality module is based on simplified approaches for stream temperature prediction that neglect important watershed factors other than riparian vegetation that can influence temperature including stream depth, channel width, groundwater inflow and air temperature (Sullivan and Adams, 1990).

Additional impacts on water temperature vulnerability are considered by the watershed assessment in this section. Natural or management-caused conditions may exist in the WAU that increase or decrease the temperature vulnerability. Table 1 lists a number of conditions related to potential changes in key environmental variables. These include the effect of natural variability or anthropogenically caused differences in channel, flow, climatic, or riparian vegetation variables, potential shade loss, relative to the assumptions on which initial vulnerability determinations are made. Criteria for identifying when differences are sufficient to consider potential effects on temperature are provided. These are based on sensitivity analysis of the effect of environmental variables on temperature found in the TFW evaluation of temperature prediction (Sullivan et al. 1990) and Sullivan and Adams (1990). The percentages provided in Table 1 are intended as guidance on conditions likely to cause significant deviation in temperature. Analysts should consider other conditions than those specified when necessary.

In addition, the presence of biologically sensitive organisms may alter vulnerability based on beneficial uses or may suggest characteristics of temperature other than the annual maximum temperature should be considered. The watershed assessment team determines whether watershed conditions exist that may require revision of temperature vulnerability. They will document conditions and modify vulnerability calls accordingly.

Similarly, the initial determination of shade hazard (likelihood of reduced shade from forest practices) is based on potential and current view-to-the-sky. Factors that may influence hazard calls for shade loss include stand characteristics that are naturally sparser than expected for the forest type, or narrowly confined canyons where topography provides additional shade. Hazard may also be increased in the region of the stream where riparian shade is important in maintaining water temperature by immediately adjacent upstream reaches that have reduced shade. Water may flow into the downstream reach at warmer temperatures than expected. The rate at which water may cool as it travels in the downstream reach depends on stream depth and the difference between actual and expected water temperature based on environmental conditions within the downstream reach. The shallower the stream or the larger the difference in water temperature, the more rapid the response.

Primary Factors Influencing Vulnerability to Temperature Change

Key Environmental Variable	Watershed Condition	Situation	Criteria for recognizing situation	Temperature Effect	Possible Change in Vulnerability
Riparian Shade	Forest stand composition	<ul style="list-style-type: none"> tree species that do not achieve expected heights 	<ul style="list-style-type: none"> Native vegetation less than 150 ft west side, 	<ul style="list-style-type: none"> warmer 	<ul style="list-style-type: none"> decrease
Riparian Shade	Channel width	<ul style="list-style-type: none"> wider than expected (sedimentation) wider than expected (wetlands) narrower than expected (canyons) 	<ul style="list-style-type: none"> more than 50% increase in channel width more than 50% increase in channel width more than 50% decrease in channel width 	<ul style="list-style-type: none"> warmer warmer cooler 	<ul style="list-style-type: none"> increase increase decrease
Stream Depth	Channel morphology	<ul style="list-style-type: none"> shallower than expected (sedimentation) 	<ul style="list-style-type: none"> reduction of stream depth of 50% or more 	<ul style="list-style-type: none"> warmer 	<ul style="list-style-type: none"> increase
Stream Depth	Low flow withdrawals	<ul style="list-style-type: none"> shallower than expected (loss of flow) 	<ul style="list-style-type: none"> reduction of stream depth of 50% or more 	<ul style="list-style-type: none"> warmer 	<ul style="list-style-type: none"> increase
Groundwater	Rate of Groundwater Inflow	<ul style="list-style-type: none"> More than expected (usually occurs at geologic discontinuities, e.g. waterfalls) Less than expected (losing reaches) 	<ul style="list-style-type: none"> Determine locally 	<ul style="list-style-type: none"> cooler warmer 	<ul style="list-style-type: none"> decrease increase
Air Temperature	Forest stand composition	<ul style="list-style-type: none"> Hardwood stands have slightly higher air temperature than conifer stands 	<ul style="list-style-type: none"> Mature hardwood dominated stands 	<ul style="list-style-type: none"> slightly warmer 	<ul style="list-style-type: none"> increase if near 16C
Beneficial Uses	<ul style="list-style-type: none"> Differences in life history requirements of fish species Sensitive fish stocks 	<ul style="list-style-type: none"> Presence of species most sensitive to temperatures other than those related to the annual summer maxima Presence of species or stocks with heightened sensitivity to selected maximum value 	<ul style="list-style-type: none"> Migrating/holding chinook or summer steelhead Sockeye or kokanee habitats Depressed or critical fish stocks Bull trout 	<ul style="list-style-type: none"> need cool temperatures for long duration Need cooler temperature than 16C 	<ul style="list-style-type: none"> increase increase

Factors Influencing Hazard to Shade Removal

Key Environmental Variable	Watershed Condition	Situation	Criteria for Recognizing Situation	Shade Effect	Potential Change in Hazard Call
Riparian Shade	Forest stand composition	<ul style="list-style-type: none"> less dense stands with high opacity 	<ul style="list-style-type: none"> Opacity factor described in WQ module is greater than 30% 	<ul style="list-style-type: none"> less than expected 	<ul style="list-style-type: none"> could increase or decrease depending on position in watershed
Riparian Shade	Existing shade level upstream of segment of concern	<ul style="list-style-type: none"> significant shade loss in adjacent upstream segments within zone of influence can result in higher temperatures entering segment of interest 	<ul style="list-style-type: none"> Current shade level more than 30% below minimum shade in zone 200 channel widths upstream in watershed area where shade influences temperature 	<ul style="list-style-type: none"> need more than minimum to prevent adverse temperature impacts 	<ul style="list-style-type: none"> increase if within zones where shade influences temperature